REMARKS

Applicants hereby request further consideration of the application in view of the amendments above and the comments that follow.

Status of the Claims

Claims 1-12 are pending the present application. Claim 2 stands rejected under Section 112. Claims 1, 2 and 5-7 stand rejected under Section 103(a) as being unpatentable over U.S. Patent No. 6,709,520 to Leycuras (Leycuras) in view of U.S. Patent No. 5,879,462 to Kordina et al. (Kordina) and U.S. Patent No. 6,740,167 to Rupp et al. (Rupp). Claims 3 and 8-10 stand rejected under Section 103(a) as being unpatentable over Leycuras in view of Kordina and Rupp and further in view of U.S. Patent No. 3,845,738 to Berkman et al. (Berkman). Claims 4 and 11 stand rejected under Section 103(a) as being unpatentable over Leycuras in view of Kordina and Rupp and further in view of U.S. Patent No. 5,667,587 to Glass (Glass). Claim 12 stands rejected under Section 103(a) as being unpatentable over Leycuras in view of Kordina and Rupp and further in view of U.S. Patent Publication No. 2001/0046768 to Mezey (Mezey).

The Rejection Under Section 112

Claim 2 has been amended to overcome the rejection under Section 112.

The Rejections Under Section 103

Claim 5 stands rejected under Section 103 over Leycuras in view of Kordina and Rupp. Claim 5 recites:

> 5. A heating device comprising:
> a housing assembly defining a processing chamber and including:
> a susceptor surrounding at least a portion of the processing chamber; and
> a thermally conductive liner interposed between the susceptor and the processing chamber, wherein the liner is separately formed from the susceptor;
> wherein the susceptor includes a susceptor core of a first material and a susceptor coating of a second material;

> wherein the second material is selected from the group consisting of refractory metal carbides; and
>
> wherein the liner is interposed between the susceptor coating and the processing chamber; and
>
> an EMF generator configured to generate an electromagnetic field to induce eddy currents within the susceptor, wherein the susceptor converts the eddy currents to heat.

An exemplary housing assembly **100** is disclosed in Applicants' specification. The housing assembly **100** may provide for a more efficient, convenient and durable heating device, particularly where a refractory metal carbide such as TaC is used for the coatings **117**, **127** on the susceptor cores **115**, **125** and SiC is used for the coatings **137**, **147**, **157**, **167** on the side susceptor cores **135**, the platter core **145**, and the liner cores **155**, **165**. The TaC coatings **117**, **127** may serve to reduce thermal radiation losses and prevent or reduce undesirable sublimation of the SiC coatings. The TaC coating in the platter region **112** of the bottom susceptor **110** may provide a more durable platform for the rotating platter **140**. The provision of the SiC coatings in fluid communication with the passage **102** and in the vicinity of the substrate take advantage of the adherent nature of parasitic SiC deposits to the SiC coatings and the chemical, thermal, mechanical, and structural similarity of the SiC coatings and the SiC substrate **5**. The SiC coatings **137** on the side susceptor members **130** may assist in reducing the heating of the side susceptors due to induction heating.

The Proposed Modification of Leycuras in View of Kordina Is Not Supported

The Action cites the duct **6** of Leycuras as corresponding to the claimed susceptor. The Action further states:

> Leycuras also teaches heating of substrate via heat radiated from the duct 6, which in turn is heated by resistive heating means 8 and 9. Leycuras further teaches that instead of resistive heating means, inductive heating means could also be used for heating the duct.
>
> Leycuras does not teach an EMF generator configured to generate an electromagnetic field to induce eddy currents within the susceptor, wherein a susceptor converts the eddy currents to heat and also do not explicitly teach that coating (second material) is made from refractory metal carbides.
>
> However, use of emf generator for generating electromagnetic field to induce eddy currents within a susceptor for converting into heat are known in the

art, as per reference cited hereunder.

Kordina et al teach a heating device comprising a susceptor 7 is heated by electromagnetic field radiated by a RF coil 9 (emf generator){eddy currents would be inherently induced within the susceptor, which get converted to heat}[for example, Figures 1-3 and column 5, line 1 to column 6, line 50}

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to use inductive heating means comprising an emf generator for heating the susceptor by eddy currents as taught by Kordina et al in the apparatus of Leycuras to enable heat the susceptor as an equivalent heating means for heating the substrate.

As noted in Applicants' previous response, the duct **6** of Leycuras is merely a thermally conductive liner. Leycuras does not teach or suggest the provision of an electromagnetic field (EMF) generator that generates an EMF field that induces eddy currents in the duct **6**. In particular, Leycuras does not teach or suggest an embodiment wherein the duct **6** converts eddy currents to heat. As such, the duct **6** is fundamentally different in purpose and function than the susceptor as recited in Claim 5. Thus, the coating to which the Action refers is not a coating on a susceptor that corresponds to the susceptor as recited in Claim 5. Accordingly, the cited art fails to disclose this aspect of the application as claimed.

Leycuras cannot properly be regarded as teaching or suggesting a device wherein the duct **6** is a susceptor that converts eddy currents to heat. Per Leycuras, the process chamber heat is generated by first and second heating means **8, 9**, not the duct **6**. *See, e.g.*, col. 5, lines 37-49. While Leycuras suggests that the heating means **8, 9** may be "induction heating means" (*see* col. 8, line 62 to col. 9, line 4), there is no apparent suggestion to use the duct **6** as an EMF-to-heat converting susceptor of an induction heating device. Rather, the ordinarily skilled artisan without benefit of Applicants' specification would interpret the cited disclosure to suggest that the resistive elements **8, 9** could be replaced with an EMF generator and susceptor (in combination). In this case, the duct **6** would still be only a thermally conductive element heated by the susceptors of the heating means **8, 9**, and would not be a part of the first and second heating means **8, 9**. Put another way, an RF radiation generator (such as the RF radiating means **9** of Kordina) standing alone is an RF radiation generating means, not a complete "heating means", and therefore is not a substitute for the heating means **8, 9**. The alternative heating means suggested by Leycuras at col. 8, line 62 to col. 9, line 4, must necessarily include its own eddy current converting susceptors, in which case

there is no reason for the duct **6** to be used as an eddy current converting susceptor.

Reference to Kordina in no way changes this. Kordina merely discloses a heating device including a susceptor **7** and an RF radiating means **9** that applies an RF field to the susceptor **7** to generate heat in the susceptor **7**. At most, one of ordinary skill in the art would replace the heating means **8**, **9** of Leycuras with the heating means of Kordina (*i.e.*, the combination of the susceptor **7** and the RF radiating means **9**) and would retain the duct **6** between the substrate and the (Kordina) susceptor **7**. There is no suggestion in Leycuras or Kordina to eliminate the duct **6** or to use the duct not only as a passive thermally conductive liner (as described in Leycuras), but also as an element that converts eddy currents to heat to generate heat. Thus, the Examiner's proposal to incorporate the duct **6** into the heating means **8**, **9** as an eddy current converting susceptor would not provide an "equivalent heating means" at all, but rather would create a materially different apparatus.

Moreover, the use of the duct **6** as a susceptor that converts EMF to heat is nonobvious and unlikely for at least two reasons. First, this would essentially eliminate the heating means **8**, **9** and incorporate their functionality into the duct **6**. Yet, Leycuras does not suggest doing that by eliminating the electrically, resistive elements **8**, **9** and making the duct **6** an electrically resistive heating element. Thus, Leycuras only contemplates using the duct **6** as an element that is heated by thermal transfer, not an element that converts electrical energy to heat. The duct **6**, interposed between the heating elements and the process chamber, appears to be a critical and necessary element of the Leycuras invention (*see*, *e.g.*, Leycuras at col. 2, lines 17-29). In fact, the background discussion of Leycuras appears to teach away from the use of the duct **6** as an EMF-to-heat converting susceptor (*see*, *e.g.*, col. 1, lines 22-48).

Second, using the duct **6** itself as a susceptor that converts an EMF from an EMF generator to heat is clearly at odds with the intended functionality of the heating means **8**, **9**. The duct **6**, by design, extends well beyond the deposition zone in either direction. The heating means **8**, **9**, by contrast, extend only along a more limited region about the deposition zone. Thus, while the device of Leycuras as described provides controlled localized or targeted heating, the modified apparatus as proposed by the Action would provide widely distributed heating. Utilizing the duct **6** as an induction susceptor would presumably

undesirably alter the thermal distribution provided and/or introduce complexity. *See, e.g.*, Leycuras at col. 5, lines 37-39 and 45-59, col. 5, line 66-col. 6, line 2, and col. 6, lines 24-26.

The Proposed Modification of Leycuras in View of Rupp Is Not Supported

Regarding the combination of Leycuras and Rupp, the Action states:

> Rupp et al teach an apparatus (Figures 1-4) for processing wafers comprising a susceptor 1 that has an insert 2 for supporting a semiconductor substrate 3. Rupp et al further teach that insert 2 has a core 11 made from graphite, and it is then coated with a metal carbide layer 6 made from metals like tantalum, niobium etc (refractory metals) [column 2, line 35 to column 3, line 20 and column 4, line 45 to column 5, line 52].
>
> Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a susceptor with a graphite core material and coated with a carbide coating of refractory metals like TaC, as taught by Rupp et al in the apparatus of Leycuras in view of Kordina to obtain susceptor that is stable at high temperatures and also does not introduce any impurity into the wafer during processing (column 5, lines 2-17).

Although Rupp does disclose a layer **6** of metal carbide on an insert **2**, it does not teach or suggest the aspect for which it is cited and, in particular, Rupp does not suggest the modification to Leycuras proposed by the Action. The insert **2** of Rupp interfaces with the process chamber or gas stream and is not covered by a liner. Thus, Rupp does not suggest the use of a coating of a refractory metal carbide on a susceptor core, wherein a liner is interposed between the coating and a processing chamber. Moreover, Rupp teaches nothing with respect to materials for use in coating a susceptor core separated from a processing chamber by a liner.

Leycuras itself does not teach or suggest the claimed invention or the proposed modification in view of Rupp. The Action contends that, by teaching that the inner surfaces of the walls **37**, **38** of the duct **6** can be coated, Leycuras teaches that the plates **70** will be interposed between this coating and the processing chamber. Even if, *arguendo*, Leycuras is understood to teach or suggest the provision of both a coating and the plates **70** (*i.e.*, the secondary duct), the suggested coating is "a prior coating of the material intended to be deposited on a substrate **10** in this reactor... so as to minimize the diffusion of any outgasing

substances during the normal operation of the reactor **1**" (Leycuras at col. 4, lines 45-53; emphasis added). Thus, it may be expected that the coating of Leycuras would be a coating of SiC or AlN, not a metal carbide, and Leycuras arguably teaches away from the proposed modification.

Regarding the proposed motivation for modifying Leycuras in view of Rupp, the insert **2** supports the wafer **3** and the ordinarily skilled artisan would therefore regard the insert **2** as corresponding to the substrate holder **29** of Leycuras, not the duct **6**. Rupp is directed to a susceptor as a support for a substrate (*see, e.g.*, Rupp at col. 1, lines 12-15). The metal carbide layer **6** is intended to prevent contaminants from diffusing into the substrate via the contact between the substrate and the surface supporting the substrate (*see, e.g.*, Rupp at col. 2, lines 1-5 and lines 51-57, col. 3, lines 7-13, and col. 5, lines 44-47). Accordingly, the insert **2** of Rupp has no apparent correspondence or relation to the duct **6** of Leycuras, which is separated from contact with the substrate **10** by not only the substrate holder **29**, but also the liner **70**.

Comments Responsive to the Examiner's Reply to Applicants' Previous Arguments

Responsive to Applicants' previous arguments, the Action states:

> Examiner responds that Leycuras teaches heating means 8, 9 and do not disclose these as susceptors. As explained above, duct 6 acts as a susceptor by transmitting the heat absorbed (from heating means 8, 9) to the substrate 10. Further, as indicated in last office action also, Leycuras also teaches that instead of heating means 8, 9 (resistive heaters), an inductive heating means could be alternatively used. Thus it would be obvious to one of ordinary skills in the art to use inductive heating means in Leycuras apparatus, by use of an EMF generator for inducing eddy currents in the susceptor (duct 6), as taught by Kordina et al.

The Examiner appears to argue that an element that absorbs and transmits externally supplied energy is by definition a "susceptor" and, once so defined, it is obvious to use such an element as a susceptor that converts eddy currents to heat in any system employing induction heating. If so, the Examiner's reasoning is based on an unsupportable premise.

In any event, there is no support for the Examiner's proposed negative inference. The failure of Leycuras to disclose the heating means **8**, **9** as susceptors implies nothing; by the

same token, Leycuras does not disclose the heating means **8**, **9** as "RF radiation generators" (*i.e.*, the other component of an induction heating means). Only a minimal mention is made of "induction heating means" in Leycuras. Leycuras merely states:

> However, other types of heating means **8**, **9** may be envisaged, even if they seem less advantageous, such as induction heating means, heating means in which the first **8** and second **9** heating means form only a single device placed all around the duct **6**, etc.

(Emphasis added.) It is implicit in the language of Leycuras that the "induction heating means" is a functional replacement for the resistive elements **8**, **9**. An RF radiation generator standing alone does not generate heat and therefore is not a functional replacement for the resistive elements **8**, **9**. Hence, Leycuras clearly implies that the resistive elements **8**, **9** would be replaced with an RF generator and a susceptor that cooperates with the RF generator to convert eddy currents to heat.

Moreover, Leycuras likewise does not refer to the duct **6** as a susceptor either. The duct **6** is an element separately recited from the heating means **8**, **9**. If Leycuras (implausibly) wished to suggest that the duct **6** could be incorporated into the heating means **8**, **9**, certainly Leycuras would have stated or at least inferred such. In any event, there is nothing in Leycuras that would imply that that the duct **6** be incorporated into the heating means **8**, **9** as a heat generating susceptor, thereby essentially eliminating its functionality as a separate interposed component of the apparatus.

Responsive to Applicants' previous response, the Action also argues:

> Applicant's argument that Leycuras appears to teach away from the use of the duct 6 as an EMF-to-heat converting susceptor (see, e.g., col. 1, lines 22-48), as indicated in the background section of reference, is not found persuasive, since Leycuras teaches use of inductive heating means for his disclosed invention by which duct 6 would be subjected to electromagnetic field and in turn would heat the substrate 9 that is, duct 6 functions as a susceptor.

The Examiner's final assertion is simply not supported by the cited art. Leycuras does not teach a use wherein the duct **6** is subjected to an EMF to generate heat.

The Action further states:

> Responding to applicants argument that duct 6 by design, extends well beyond the deposition zone and using the duct 6 as an induction susceptor would presumably undesirably alter the thermal distribution, examiner responds that since Leycuras has not disclosed details of induction heating means, Kordina reference is used that teaches use of EMF generator for inducing eddy currents in susceptor for heating the same as per claim limitation, as also explained below.

Leycuras does not disclose details of the induction heating means type of heating means **8, 9**, but Leycuras does provide relevant details regarding the heating means **8, 9** generally and relative to the duct **6**, in particular. For example, it is readily apparent from the drawings that the heating means **8, 9** extend less than half the length of the duct **6**. It is also readily apparent from the disclosure as a whole that reducing energy consumption and improving temperature distribution are objectives of the Leycuras apparatus. Therefore, the proposed modification to Leycuras (*i.e.*, using the duct **6** as an eddy current-to-heat converting susceptor) is at odds with the teachings of Leycuras.

The Action further argues:

> Applicant argues that Rupp does not suggest the modification to Leycuras as proposed by the office action and that Rupp does not suggest the use of a coating of a refractory metal carbide on a susceptor core, wherein a liner is interposed between the coating and processing chamber.
>
> Examiner responds that Rupp teaches use of Tantalum as a preferred material for forming carbide coating on graphite insert prevent impurity being introduced into silicon carbide by the carbide cations. Thus the use of such a coating would be applicable (including on a susceptor) in SiC processing environments (column 5, lines 1-50). Further, Leycuras does not explicitly teach that duct walls are not coated when a liner is present.

Applicants respectfully submit that what Leycuras "does not explicitly teach" cannot properly be regarded as support for whatever proposed modification to Leycuras the Examiner wishes to assert. Rupp discloses use of tantalum for very particular applications, none of which are applicable or analogous to the duct **6** of Leycuras. These observations likewise apply to the Examiner's arguments as presented in paragraphs 6) and 7) of the Action.

Summary

In summary, the proposed modification to Leycuras is not only not supported by Leycuras, but would also substantially and fundamentally alter the construction and functionality of the Leycuras apparatus. The Examiner proposes to replace the resistive elements **8, 9** with an RF coil and convert the duct **6** from a mere thermally conductive liner to an active heat generating (EMF-to-heat converting) susceptor. This proposed modification is contrary to the relevant disclosure of Leycuras. Moreover, such a modification would, in effect, convert the duct **6** to a heating means (having a significantly different extent and distribution than the heating means **8, 9**) and eliminate the important functionality of the duct **6** as described by Leycuras. There is no reason apparent why one of ordinary skill in the art would so significantly deviate from the teaching of Leycuras. The Examiner's proposed modification of Leycuras in view of Rupp is also in error. Rupp discloses a coating for a particular purpose and location in a processing environment, which are very different from the purpose and location of the coating on duct **6**. There is no apparent reason why the ordinarily skilled artisan would modify the duct **6** in view of Rupp's nonanalogous implementation.

In view of the foregoing, Applicants respectfully submit that Claim 5 is patentable over the cited art. Claims 1-4 and 6-12 depend from Claim 5 and are therefore allowable for at least the foregoing reasons. At least certain of the dependent claims are further distinguishable from the cited art, as follows.

Claim 12

Claim 12 depends from Claim 5 and further recites that "the liner includes a portion formed of SiC interfacing with the processing chamber." Claim 12 is separately rejected under Section 103 over Leycuras in view of Kordina and Rupp and further in view of Mezey. The Action states:

> Leycuras in view of Rupp et al does not explicitly teach that liner is made from silicon carbide.
>
> Mezey teach an apparatus for semiconductor processing (Figure 4) comprising:
>
> A processing volume including a velocity gradient plate 150 (liner)

> that defines channel for gas flow near substrate and where the velocity gradient plate is made from silicon carbide (paragraph 0076-0080).
>
> Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a liner made from silicon carbide as taught by Mezey in the apparatus of Leycuras in view of Kordina et al and Rupp et al, to enable use a liner that is compatible with SiC processing environment and also provide control of gas flow volume near substrate and improve uniformity of deposited layer)[paragraph 0082].

Mezey does not satisfy the deficiencies as discussed above with regard to the rejection of Claim 5 over Leycuras in view of Kordina and Rupp. As discussed above, Rupp teaches a metal carbide layer **6** that interfaces with the process chamber. Even if the ordinarily skilled artisan wished to provide a velocity gradient plate, it is not apparent why said artisan would provide a coating of TaC on the duct **6** of Leycuras if the duct **6** were already protected by a shield **70** of SiC.

CONCLUSION

Applicants submit that the present application is in condition for allowance and the same is earnestly solicited. Should the Examiner have any matters outstanding of resolution, he is encouraged to telephone the undersigned at 919-854-1400 for expeditious handling.

Respectfully submitted,

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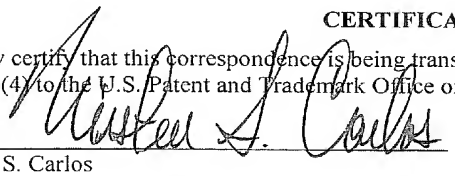

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